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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SUMMARY REVIEW OF MONTHLY REPORTS¹
FOR
SOIL CONSERVATION SERVICE--RESEARCH²
JANUARY 1952

EROSION CONTROL PRACTICES DIVISION

Value of Legumes in Pasture - D. D. Smith, Columbia, Mo.

Some information on the value of legumes in pasture is available from the alta fescue plot managed for winter pasture. Ladino clover was seeded in one end of the area in the spring of 1949. Since that time it has spread in the old stand of fescue. Samples of the sward collected November 29 in the two sections--one with and the other without Ladino--were analyzed for total nitrogen by the Agricultural Chemistry Department of the University of Missouri. This was converted to protein using the conventional factor 6.25. Amount of standing forage and protein available for the winter period are indicated below:

	<u>With Ladino Clover</u>	<u>No Legume</u>
Total yield (tons/acre)*	1.41	1.24
Crude protein (percent)	11.1	10.4
Crude protein (lb./acre)	313	248

*Adjusted to 15 percent moisture.

"The area is being grazed as a single unit, and production data will not be available for the two sections. Thirteen head of coming-2-year-olds have been on the 5-acre area since December 5. They have access to the hay stacked from the area last July after seed harvest. The cattle showed a definite preference for the section of the pasture with clover, and until late January went to the hay stack only when ice and snow covered the plot. Estimates on January 31 of the hay remaining in the stack and growth on the plot indicate sufficient forage to carry the cattle to grass in April."

Summary of Tobacco Irrigation 1949-50 - C. S. Britt, Beltsville, Md.

"Tobacco is the most important crop grown in the five tobacco producing counties of southern Maryland. Erosion is normally a serious problem on tobacco land in this area. A successful erosion control practice has been developed at Beltsville, Md., and applied on several cooperating farms. This practice requires considerable initial expense in land smoothing in order that proper row grades may be laid out. Our interest in supplemental irrigation on land thus treated is to know if water applications may be economically used to enhance crop yields during seasons of deficient rainfall and thus serve as an added crop insurance. During the years 1949 and 1950 we have carried out studies of supplemental irrigation with tobacco grown on ridged rows with controlled row grades. The soil used

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²All researchwork of the Soil Conservation Service is in cooperation with the various State Experiment Stations.

was a Muirkirk loamy sand.

Summary -"(1) Two irrigations without extra fertilizer caused serious crop depression as in 1949. When supplemental potash alone was applied with two irrigations the yields and values were further depressed. When supplemental nitrogen alone was applied with two irrigations the crop depression was partially offset.

"(2) Two irrigations plus a soluble many-element fertilizer was slightly better than rainfall only. Where potash was added with the soluble fertilizer the results were about the same.

"(3) Where extra nitrogen was applied with the soluble fertilizer and irrigations, an excellent increase in tobacco yield, value, and quality was obtained. The experiment did not include an application of the soluble fertilizer without the two irrigations.

"These studies suggest that (a) supplemental irrigation alone may tend to decrease tobacco yields and values, (b) supplemental irrigation applied in conjunction with skillful supplemental use of fertilizer shows promise for economic increases in tobacco yields and values."

Increased Net Farm Income from Erosion Control Practices - E. L. Sauer, Urbana, Ill.

"Sixteen years of farm record studies of the costs and benefits of soil conservation on more than 450 Illinois farms prove that sound conservation programs maintain and improve soil resources, increase farm yields, and boost production and income.

"In a recent analysis of physically comparable high- and low-conservation farms in three areas of Illinois and covering a 10-year period, it was found that the adoption of soil conservation and fertility improvement practices and improved general level of management resulted in increased production and earnings on the high-conservation farms. At 1945 prices, the 10-year average per acre increases in net farm income on the high-conservation compared to the low-conservation farms were \$4.77 for McLean County, \$6.41 for Stephenson, Jo Daviess, and Winnebago Counties, and \$6.97 for Madison and St. Clair Counties. Capitalizing these increases at the going rate, conservation increased land values in the three areas by \$95, \$128, and \$139 an acre, respectively.

"In general, the high-conservation farms had less soil and water erosion and the fertility level of their soil was improved.

"Both landlords and tenants, farming under crop share leases on a grain farm, stand to gain from the adoption of a conservation program. Records from tenant operated cash grain farms in central Illinois show that the adoption of a sound land-use program and fertility improvement and erosion-control practices increased average net incomes of both landlord and tenant from 25 percent to 30 percent within 3 years after the start of the conservation program on these farms.

"A good conservation plan lays the foundation for a complete farm program. Studies show conclusively that well-planned systems of farming that conserve the soil have been profitable under a wide variety of conditions. In each Illinois area studied, production and incomes on the high-conservation farms were relatively better at the end of the period than at the beginning. In most cases an improvement was shown soon after the program started. The present national and world

situation calls for long-time high agricultural production in terms of bushels and tons of food, feed, and fiber. This can best be achieved by widespread adoption of programs of sound land use and soil and water conservation and fertility improvement practices."

Crop Yields from Crop Rotation - F. L. Duley, Lincoln, Nebr.

"One of the principal activities during January was a sort of workshop conference of Operations and Research men in this region. The week of January 14 to 18 was devoted to presentation of papers by both Research and Operations men concerning the work in progress, as well as the problems confronting the Service. There was much discussion of methods and work that is needed."

Table 1.--Comparative mean yields of corn, oats, and wheat at Lincoln, Nebr., in a bromegrass, a sweet clover, and a non-grass non-legume rotation. Also mean yields of residues.

Rotation	CORN ¹		Pounds residues per acre	
	Bu. per acre			
	Sub-tillage	Plowing	Subtillage	Plowing
1 - First yr. corn after bromegrass	53.7	53.3	2,985	2,975
2 - " " " " 1-yr. sw.clover	65.7	65.5	3,450	3,510
3 - Corn in corn-oats-wheat rotation	46.0	49.0	2,565	2,500
1 - Second yr. corn after bromegrass	51.8	55.6	2,680	2,870
2 - " " " " 1-yr.sw.clover	61.4	63.9	3,145	3,275
3 - Corn in corn-oats-wheat rotation	44.4	49.0	2,490	2,480

OATS ²				
1 - Oats in bromegrass rotation	29.2	31.8	1,125	1,260
2 - Oats as nurse crop for sw.clover	38.8	-	1,640	-
3 - Oats in corn-oats-wheat rotation	26.2	25.1	1,010	1,045

WHEAT ³				
1 - Wheat in bromegrass rotation	29.0	30.6	2,855	3,190
2 - Wheat in corn-oats-wheat "	26.1	27.0	2,450	2,635

¹Six crops.

²Five crops.

³Four crops.

Erosion Control Practices - B. H. Hendrickson, Watkinsville, Ga.

"Runoff occurred from three rains during the month causing only slight erosion. The oat plots consistently yielded more runoff than continuous cotton. This is a good indication of what smooth crusted conditions with little cover will do and points up the benefits of what contour row beds with a little mulch litter from cotton leaves and stalks will do toward retarding winter runoff.

"Generally mild weather in January has stimulated good growth of cool-weather grasses and legumes. Kentucky fescue, oats-crimson clover, and rescue grass have furnished very good winter grazing during the month.

"First-year Kentucky fescue, sown in early fall on a large field previously improved by several year's growth of sericea lespedeza, is making outstanding growth. Similarly, wherever cool-weather grasses are growing on land built up by kudzu, winter production of grazable forage is excellent."

Erosion Control Practices - G. N. Sparrow, Tifton, Ga.

"An interesting observation, made not only on research plots but on other areas on the Experiment Station, is that stands of Blue lupine are better where they are following small grain than when they are following peanuts. Stands immediately following germination of seed were comparable. Following the first heavy frost and freeze, lupine plants after peanuts died in greater quantity than following small grain. The difference in stands is currently quite obvious and is tentatively considered a pathological problem rather than a direct result of cold damage."

Mechanical Treatments Applied to Old Seeded Pastures of Low Productivity at Archer - O. K. Barnes, Laramie, Wyo.

"The data summarized in this report are from a study of various mechanical treatments applied to some old seeded pastures of low productivity at Archer. The three pastures used for this study were established in 1941 and were under experimental grazing until 1950. During this period the productivity of these pastures declined to a level approaching native range. This decline in production was not associated with any noticeable change in amount of ground cover afforded by the grasses. The treatments applied to these pastures were for the purpose of increasing the forage production.

"The yields of forage indicate only a slight response to the treatments tested on crested wheatgrass and western wheatgrass. Ripping at 5- and 8-inch depths and plowing the grass into 42-inch rows with and without a legume seeding increased the yield up to about 200 pounds per acre over the check. Considering the cost of applying these treatments it is doubtful that these small increases would justify the practice. In addition to the cost such treatments have the disadvantage of greatly increasing the amount of bare ground as compared with the check plots.

"Russian wildrye showed the greatest response to these mechanical treatments. Increased yields resulted from all treatments applied. The outstanding increases resulted from plowing this grass into 42-inch rows, and the greatest increase with this treatment was made by the plots that had legumes introduced. Even though this treatment greatly increased production of Russian wildrye it leaves so much bare ground (it provides less than one-fourth the cover found on the check plot) that under most conditions the treatment would be of doubtful value as an improvement practice.

"In general and on the basis of results from these trials it appears that mechanical treatments offer little opportunity of significantly increasing production of old crested wheatgrass and western wheatgrass stands. Russian wildrye shows marked response to rather severe tillage and thinning treatments have the disadvantage of leaving a considerable amount of ground bare."

Erosion Control Practices - F. W. Schaller, Ames, Iowa

"A summary of soil and water-loss measurements from the control plots at Clarinda is presented in table 1. Runoff and erosion were high in 1951 because

of heavy rainfall. This year corn following a brome-alfalfa-red clover meadow lost 14 tons of soil per acre. But corn grown continuously lost from 46 to 52 tons per acre. Runoff from continuous corn was more than twice that from rotation corn.

Table 1.--Soil and water losses from corn, Marshall silt loam, Clarinda, Iowa, 1951

Cropping system ¹	Soil loss tons per acre	Runoff inches
Corn-oats-hay rotation for 21 years	13.7	2.77
Continuous corn for 21 years	46.0	7.35
Continuous corn for 9 years	51.9	5.17

¹Hay was a mixture of alfalfa, red clover, and brome-grass

"Corn yields from the control plots at Clarinda were unusually low this year. (See table 2.) Unfavorable weather conditions and late planting (June 5) were main factors causing low yield. However, the data in table 2 show clearly how grass and legumes in a rotation improve the soil and increase corn yields as well as controlling erosion.

Table 2.--Corn yields from Clarinda control plots, 1951

Cropping system ¹	Corn yields Bushels per acre
Continuous corn for 21 years	9
Continuous corn for 8 years	32
Corn-oats-hay rotation for 9 years	54
Corn-oats-hay rotation for 21 years	63

¹Hay was a mixture of alfalfa, red clover and brome-grass.

"Soil and water losses at the Western Iowa Experimental Farm are shown in table 3. These plots are located on Ida silt loam soil with an average slope of 14 percent.

"The 1951 season was high in rainfall, and erosion losses from corn were generally high. The heavy rains, especially in May and June, served well to demonstrate the effectiveness of cropping systems on runoff and erosion. This is shown in table 3.

Table 3.--Effect of cropping systems on soil and water losses, Ida silt loam, 14-percent slope, Western Iowa Experimental Farm, 1951¹

Cropping system	Soil loss (tons per acre)	Runoff (inches)
<u>From Corn</u>		
Corn-oats (sweet clover catch)		
Surface planted up-and-down hill	45.92	6.97
Surface planted on the contour	33.47	6.42
Contour listed	5.68	3.90
Corn-oats-meadow-meadow		
Contour listed	3.74	1.58

¹ Total rainfall in 1951 = 42.85 inches. Length of slope = 72.6 ft.

"In 1951 cornland that was planted up-and-downhill lost 45.92 tons of soil per acre. This represents about one-third of an inch of topsoil. Contoured corn lost 33.47 tons per acre, and contour-listed corn 5.68 tons per acre. These results were obtained from corn grown in a corn-oats (sweet-clover catch) rotation. Some additional saving in soil was obtained in the corn-oats-meadow-meadow rotation."

Drought Conditions and Soil Organic Matter Determinations - R. M. Smith, Temple, Tex.

"Rainfall 0.46 inch for the month, which is 2.11 inches below normal. This adds up to extreme drought, and the small grain plus clover fields are suffering very seriously. All of our 103 calves have been on small grain with clover grazing since December 12, but some dry-lot feeding will be necessary immediately unless there is rain.

"Depleted soil-moisture levels are confirmed by soil samples. Houston black clay soil still contains considerable available moisture to 4 feet, especially where bedded fallow, but Austin clay on slopes is almost at the wilting point. The soil difference shows very distinctly in the condition of small grain and clover.

"Some additional soil organic-matter determinations have been completed from plots on level Houston black clay land. These show a decline of 0.13 percent of organic matter from 4 years of continuous cultivation to row crops, and an increase of 0.14 percent from 4 years of continuous legumes. There was a slight decline of 0.03 percent for all of the plots in crop rotations. Data on sloping land, previously reported, show a decline of 0.15 percent from continuous cultivation, an increase of 0.06 from continuous legumes, and a decline of 0.06 percent for all rotations. The organic-matter levels involved are not high on either the level or the sloping land. They vary from 2.5 percent to 3.0 percent. Agreement is good between the two locations as to the effects of cropping."

Investigation of Reduction in Yield Caused by Use of a Mulch - G. D. Brill, New Brunswick, N. J.

"The value of an applied surface mulch during the cropping season in

conserving soil and water has been proven consistently. However, two previous investigations at Marlboro have resulted in reduction in yields where a mulch was used. During 1951 we started a new plot study to further investigate this problem. Treatment consisted of clean cultivation with no mulch, a surface application of chopped hay, a surface application of wood chips, and a heavy hay mulch. Tomatoes were grown on all plots. The mulch was applied after the plants were set out and all plots except those with the heavy mulch were cultivated enough to control weeds. Sweeps were used to leave as much of the mulch material as possible on the surface. The same fertilizer applications were made on all plots. Tomato yields from these areas are shown in table 1.

Table 1.--Effect of applied surface mulches on tomato yield

Treatment	Total yield Tons/acre	Yield as of Sept. 1	
		Tons/acre	% of total
Check	16.23	4.29	26
Wood chip mulch	13.85	5.55	40
Chopped hay mulch	13.07	4.50	34
Heavy hay mulch	18.21	3.66	20
No cultivation			

"The above data clearly show a reduction in yield of tomatoes with a light application of wood chips or chopped hay. This may be due to a nitrogen deficiency. This will be investigated during the coming season.

"The high yield from the heavily mulched area with no cultivation is a direct reversal of previous results. This may possibly be due to improved moisture conditions under the mulch. Rainfall during August and September was 4.10 inches less than normal. Eighty percent of the yield from the heavily mulched areas was harvested after September 1. We intend to continue this study with additional nitrogen applications to part of the plot areas."

Data on Effect of Slopes on the Utilization of Rainfall - H. H. Finnell, Goodwell, Okla.

"Assuming that the natural water relations of the land may have something to do with adopting practical slope limits of Classes A, B, and C lands, I find a very interesting fact cropping out in a study of the High Plains hardlands of the Texas Panhandle from Ochiltres District on the north to Floyd District on the south. The break in moisture-storage efficiency in both these areas occurs between 1 and 1.5 percent and between 3 and 3.5 percent slopes. If we called 0 to 1 percent an A slope and rated its average moisture-storage efficiency at 100, the natural limits of B slopes would be 1 to 3 percent with an efficiency rating of 85, while C slopes would be 3 to 4.5 percent with an efficiency rating of 60. This is not like any slope classifications which have been used heretofore, but so far as I know, this is the first time we have had reliable information on the effect of slopes on the utilization of rainfall. These findings at least suggest the desirability of exploring new criteria for slope classifications based not upon uniform percentage rate limits but upon the relative effect of different slopes upon basic moisture relations which would mean different percentage limits for A, B, and C slope classes in different climatic areas and possibly different soil textures within a climatic area."

Nitrogen Content of Crops, 1951 - C. J. Whitfield, Amarillo, Tex.

"It is characteristic of the wheat plant for the period of most rapid sorption of nitrogen to precede the period of most rapid growth. This results in a peak of nitrogen content of the plant taken as a whole. In 1951, this occurred near the last of April. As growth exceeds the rate of nitrogen sorption, the nitrogen content of the plant falls. In 1951, the time of most rapid growth occurred during the last half of May. As the heads develop, up to three-fourths of the nitrogen of the straw is translocated to the heads and nitrogen content of the straw falls to a low level.

"Subtitled wheat plants were in general lower in nitrogen than the one-wayed and wheat on delayed subtitled fallow lower than on conventional subtitled fallow. This is in agreement with the relative levels of soil nitrate-nitrogen usually observed on the plots. The nitrogen content of heads and grain was much less variable with tillage than the rest of the tops. It is surprising that there should be pronounced differences in the nitrogen content of the mature straw yet this proved to be the case. At maturity, the most pronounced difference in nitrogen content was in the chaff, the composition of the other parts of the plant being much more uniform. The nitrogen content of the mature straw was unexpectedly high, ranging from 0.66 to 0.88 percent compared to the value of 0.50 percent usually assumed for wheat straw. Greenbug and drought damage may have been responsible for this. Some plants were sampled on June 2, which showed the characteristic flat, compressed heads partially enclosed by the boot, and thick brittle stems characteristic of greenbug wheat. The nitrogen content of the straw and heads of these plants average 2.68 and 2.44 percent nitrogen, respectively. This was much higher than for the other wheat samples taken on May 28, and were unusual in that the straw was higher in nitrogen than the heads. Wheat grain in 1951 was exceptionally high in protein and ash as well as test weight.

Protein Content for the 1951 Crop - F. H. Siddoway, St. Anthony, Idaho

"The protein content of wheat for the 1951 crop was abnormally high. Climatic conditions favored high protein formation. Vegetative growth was relatively light and there was ample available nitrogen for maximum protein formation. The wheat was shriveled slightly and test weights were low.

"There was a 0.36 reduction in protein content for the moldboard plow compared to the subsurface plow for all plots. The widest difference in protein content between the two stubble placements was for the no-treatment plots. In this case, the moldboard plow was 1.11 percent higher than the subsurface plow. The application of nitrogen fertilizer narrowed this difference considerably, indicating there is a fixation of available nitrogen by the surface straw. When the average yield is multiplied by the percent protein for each of the two stubble placements, the total amount of protein per acre produced is 246 lbs. for the subsurface plow and 233 lbs. for the moldboard. This year surface placement of straw was more efficient in utilizing the available nitrogen than plowing the straw under."

1951 Low in Both Rainfall and Soil Loss - T. L. Copley, Raleigh, N. C.

"A point of particular interest noted in the tabulation of 1951 data is the rainfall deficiency for 1951. Less than 33 inches fell during the year, which is almost 14 inches below normal. There were only 5 months in which runoff occurred, and soil loss from the control plots was less than half the usual yearly amount.

Another unusual result in 1951 shown by the soil loss data was the relatively high loss during November following the seeding of winter covers on clean, freshly prepared soil. The one major storm period during the month had high intensity rains for the time of year. Also, the soil surface was cleaner than usual because of thorough land preparation preparatory to a soil fumigation treatment preceding the seeding of winter cover. These heavy November soil losses illustrate the fact that hard rains on freshly prepared winter cover land may become a serious erosion hazard where all surface residue has been turned under or destroyed."

DRAINAGE AND WATER CONTROL DIVISION

Hydrologic Studies - L. L. Harrold, North Appalachian Experimental Watershed, Coshocton, Ohio

"Precipitation which occurred on 21 out of the 31 days of the month totaled 5.65 inches--well over normal. As some frost was in the ground part of the time, opportunity is provided for evaluation of infiltration rates for frozen soil. Thunderstorm having 3-minute maximum intensity of 3 inches per hour was unusual for this month. The extremely wet soil conditions and some frost in the soil combined to yield high runoff totals as shown below. Both vegetal cover and soil permeability affected rates and amounts of runoff.

Watershed No.	Area	Soil drainage	Land use	Runoff	
				Total	Maximum rate
	Acres			Inches	Inches per hour
131	2.12	Well	Woods	0.22	0.04
132	.59	Slow	Woods	.55	.11
129	2.71	Well	Pasture	.58	.19
121	1.42	Well	Rotation meadow	.96	.21
123	1.37	Slow	Rotation meadow	2.13	.41
111	1.18	Slow	Rotation wheat	3.28	.48
196	303	Mixed	Mixed	5.89	.30

"As runoff from the 303-acre watershed totaled so much greater than runoff values from the smaller watersheds, it is reasonable to conclude that over 80 percent was comprised of seepage flow."

Hydrologic Studies - R. W. Baird, Blacklands Experimental Watershed, Waco, Tex.

"Rainfall for the month of January totalled 1.69 inches at Gage No. 69 compared to the normal of 2.19 inches. The rain of January 21 included 1.1 inches in 1 hour. This heavy rainfall was centered over the Y area and did not extend to the drainage area above the water-supply lake. In the areas of heaviest rainfall there was a trace of runoff from a few areas which included shallow cultivated land, and deeper cultivated land where the fields had not been plowed, but disked and seeded to winter clover. This rainfall has been sufficient for winter crops to make reasonable growth, but no appreciable runoff has occurred since February 12, 1950, almost 2 years.

"J. B. Pope reports that soil samples taken on January 24, following a rain of 1.22 inches on January 21, in cultivated fields in the Y-10 and W-10 watersheds showed the following percentages of moisture at the designated depths:

Y-10 Area: 0-6 inches, 27.6 percent; 6-12 inches, 26.3 percent; 12-24 inches, 23.2 percent; 24-36 inches, 21.3 percent; 36-48 inches, 22.9 percent; and 48-60 inches, 24.9 percent.

W-10 Area: 0-6 inches, 24.1 percent; 6-12 inches, 22.5 percent; 12-24 inches, 21.3 percent; 24-36 inches, 20.4 percent; 36-48 inches, 21.1 percent; and 48-60 inches, 23.1 percent.

"Oats and winter peas furnished 20 days of grazing during the month. This is the first season out of four that the peas in the corn-winter peas, cotton, and oat-Hubam system have made enough growth in December and January to graze. All of the oats in the corn, oats-sweet clover, and cotton system in the Y area were grazed during the month."

Hydrologic Studies - J. A. Allis, Central Great Plains Experimental Watershed, Hastings, Nebr.

"The Research-Operations Technical Conference in Lincoln, Nebr., January 14-18, 1952, was the first in this region to bring together technicians of both research and operations over such a wide area. Many interesting papers were presented, personal contacts were conducive to a better understanding of our problems. The meetings were well planned and organized and it is hoped that future meetings of this caliber can be held."

"January was mild and dry. The average wind velocity was 9.3 miles per hour and the temperatures were 2.3 degrees above the long-time average. Only 0.24 inch of precipitation was received during the month."

"The following table shows comparative data on Watershed W-3, containing 481 acres untreated and Watershed W-5, containing 411 acres which is 65 percent treated. The period covered is from June 1 to July 12, 1951:

Table 1.--Rainfall, runoff, and maximum peak discharge, watersheds W-3 and W-5, June 1 to July 12, 1951

1951 storm periods	Weighted rainfall		Total runoff		Rainfall minus runoff		Column (6) minus (5) where R. O. occurred	Max. peak in/hr.	
	W-3	W-5	W-3	W-5	W-3	W-5		W-3	W-5
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
June 1-2	4.05	4.80	2.38	2.30	1.67	2.50	+0.83	1.31	0.93
" 5	.01	.01	0	0	.01	.01		--	--
" 6	.30	.35	T	T	.30	.35		.002	.001
" 6-7	.95	1.02	.41	.39	.54	.63	+ .09	.16	.12
" 8	.12	.11	T	T	.12	.11		.004	.001
" 13-14	.80	.78	.22	.18	.58	.60	+ .02	.24	.08
" 14-15	.09	.06	T	0	.09	.06		.002	0
" 17	.01	.13	0	0	.01	.15		--	--
" 18	.03	0	0	0	.03	0		--	--
" 21	.48	.50	0	0	.48	.50		--	--
" 22	.85	.92	.27	.23	.58	.69	+ .11	.10	.06
" 24	.01	0	0	0	.01	0		--	--
" 25-26	1.87	1.67	1.00	.70	.87	.97	+ .10	.63	.25

Table 1.--Rainfall, runoff, and maximum peak discharge, watersheds W-3 and W-5, June 1 to July 12, 1951--Continued

1951 storm periods	Weighted rainfall		Total runoff		Rainfall minus runoff		Column (6) minus (5) where R. 0 occurred	Max. peak in/hr.	
	W-3	W-5	W-3	W-5	W-3	W-5		W-3	W-5
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
June 27	0.10	0.12	0.01	0.01	0.09	0.11	+0.02	0.005	0
" 29	.04	.03	0	0	.04	.03		--	--
July 10-12	5.04	5.14	3.04	2.54	2.00	2.60	+ .60	1.74	.87
Total for 6-week period	14.75	15.66	7.35	6.35	7.42	9.31	+1.89		

Hydrologic Studies - R. B. Hickok, Lafayette, Ind.

"Mr. Stoltenberg has practically completed analysis of the soil and nutrient loss data and drafting of a paper on 'Selective Loss of Plant Nutrients by Erosion.' He has prepared especially for this report the following summary covering some phases of that work:

"In order to properly evaluate land use programs and to determine whether or not the soil fertility levels are increasing or decreasing in intensively cropped areas it is necessary to have values for loss of plant nutrients by erosion. Erosional losses of plant nutrients from 12 rotation cropped, 3-acre watersheds have been determined for each storm period since 1944. Since 1945 the rotation has been corn, soybeans, wheat, and meadow. Six of these watersheds have been farmed under the prevailing farming system, and conservation practices have been established on the other six. These conservation practices consist essentially of contour cultivation and the development of a higher soil fertility level.

"The mean annual losses for the period 1947-50 for each farming system are listed in table 1. Several methods of analysis indicate rainfall rates and amounts to be about normal for the period. Despite the larger amounts of fertilizer applied to the conservation-practice watersheds it appears that these practices have resulted in over a 50 percent saving in nutrient losses (with the exception of K₂O).

"Although an annual soil loss of 2 tons per acre may not cause serious erosion, from a physical standpoint, it is costly. To replace these nutrients lost by erosion under the prevailing-farming system would cost \$12.60 per acre per rotation at present fertilizer prices.

"Studies of the relationships between the losses of total solids and losses of the several plant nutrients show conclusively that erosion is a selective process whereby the eroded material contains considerably more plant nutrients than the soil from which it was eroded. The process is related to the hydraulic characteristics of the runoff. This process leads to: (1) Exhaustion of the fertility elements of the soil; (2) decreases in organic-matter content, and (3) changes in the texture. Further details of the process will be given in subsequent reports."

Table 1.--Mean annual nutrient losses by erosion, Purdue-Throckmorton Farm
1947-50

Practices	Total solids	Organic matter	N	*P ₂ O ₅	*K ₂ O	CaCO ₃ and MgCO ₃
Pounds per acre per year						
Prevailing	4,180	170	11.6	3.9	3.0	64
Conservation	1,440	68	5.0	1.7	2.2	30
Difference	2,740	102	6.6	2.2	0.8	34

*In forms readily available to growing crops.

Hydrologic Studies - A. W. Cooper, Auburn, Ala.

"The January rainfall of 3.52 inches represents 73 percent of the 71-year average of 4.85 inches for Auburn.

"One rain of 1.50 inches caused a small amount of runoff and soil loss (table 1)."

Table 1.--Soil and water losses from erosion plots, Auburn, Ala.¹

Plot No.	Slope percent	Vegetative cover	Rainfall - 1.50 inches 1/28/52	
			Water loss inches	Soil loss lb./acre
1	2-1/2	Alfalfa	0	0
2	5	Crimson and rye	0	0
3	5	Crimson and rye	0.37	0
4	5	Cornstalk mulch	.29	0
5	10	Fescue and Ladino	.99	0
6	10	Cornstalk mulch	.42	0
7	10	Fescue and Ladino	.37	93.5
8	10	Crimson	0	0
9	20	Crimson	0	0
10	20	Crimson	0	0

¹All work is cooperative with the Alabama Agricultural Experiment Station.

Hydrologic Studies - T. W. Edminster, Blacksburg, Va.

"At the request of Mr. C. M. Jones, the detention-discharge method of runoff estimating was applied to a 700-acre watershed in Nottoway County assuming conditions as indicated by Mr. Jones. Since the result of this computation was a mechanical spillway, approximately 45 feet wide due to a stipulated low permissible flood stage of only 3.3 feet, the calculation will be extended to design a much narrower mechanical spillway with considerably greater flood stage."

Hydraulic Studies - F. W. Blaisdell, Minneapolis, Minn.

"The pipe spillway remodeling was completed to the point where water could be run through models. A pipe entrance projecting into the reservoir was tried, the entrance being that of the groove end of concrete pipe. The entrance did not operate as well as was hoped. The construction at the entrance was so great that the pipe could not be depended upon to flow full. A well-rounded pipe entrance was tried and this entrance is more likely to insure that the pipe will flow full. No tests have been made, the above information being observational only.

"Intense vortices were observed over the pipe entrance for both inlets. These vortices served to greatly decrease the flow through the spillway. Their elimination will require some type of construction and this construction will defeat, at least partially, one of the advantages of this inlet, that is its simplicity and economy.

"The presence of vortices lead to a study of their properties. If there are no vortices or if the vortices are so small that their effect can be neglected, the model results can readily be scaled up to the prototype and the prototype discharge reliably predicted. However, if there are vortices, their presence apparently is due to the viscosity of the water. As is customary in this type of model study, the viscosity effects were considered to be so small that they could be neglected or, in the case of pipe friction, corrections were made for the effect of viscosity. So little is known about vortices that I have been unable to find any method of predicting their effect on the prototype or for correcting for their effect on the model. Therefore, at this time we cannot say definitely whether large vortices will occur in field structures. For safety's sake, it appears that headwalls to break up vortices should be used until we can definitely determine whether large vortices will occur in the prototype that will affect the prototype discharge.

"We could exactly simulate vortices in the model if we could use a liquid with a kinematic viscosity equal to the kinematic viscosity of water times the scale ratio raised to the three-halves power. Unfortunately in this case, water has one of the smallest kinematic viscosities of any liquid and, apparently, there is no liquid available having the desired low kinematic viscosity.

"It is possible that some information could be obtained using air as the fluid. This would permit kinematic viscosity similarity in model and prototype. This possibility should be studied further before making any decision. A second alternative is to run full-scale tests. This is a costly procedure and, if some other alternative can be worked out, probably should be reserved for checking purposes rather than used for routine testing. A third alternative is to make a fundamental study of vortices to determine their characteristics and methods of scaling up their effects to prototype structures. It is hoped that some graduate student will begin such a study in the near future. However, the answer to our problem will be slow in coming if sole dependence is placed on thesis studies. The importance of this problem to Operations may make it desirable both economically and technically that we undertake fundamental studies of vortices ourselves."

Drainage Studies - J. C. Stephens, West Palm Beach, Fla.

"A meeting of a committee, composed of J. M. Weir, O. C. Lewis, and J. C. Stephens, was held to discuss methods for best carrying out a coordinated program between the Operations and Research of the Soil Conservation Service, and the

Central and Southern Florida Flood Control District, for the Kissimmee and Upper St. Johns Watershed program. It was the decision of the committee to recommend that the Central and Southern Florida Flood Control District make available \$3,500 to cover the expenses of a competent engineer to prepare a report compiling existing available data pertinent to the water-control works in connection with this program, and to determine what additional data would be needed that the Service may be expected to supply to the District under the terms of the Memorandums of Understanding between the two agencies. SCS is to prepare plan and to:

1. Assemble as quickly as possible all available data on the basic soil and water-management problems pertaining to agriculture in the District.
2. Determine what additional information is needed to provide full and complete information necessary for the planning of a comprehensive system for water control in the District that will provide for the use of each acre of agricultural land within its capabilities and the treatment of each acre of such land in accordance with its needs for protection and improvement.
3. Present at the earliest date feasible the results of these findings in the form of a report which may be used for the guidance of the District and the information of the public.

"The two 10.5-foot steel evaporation tanks were installed in the hydrologic plot at the Everglades Experiment Station. These tanks, 5.5 feet deep, will be used to verify the previous land tank evaporation results at the Everglades Experiment Station, and will extend the records of these studies. One tank is finished with an aluminum surface and the other will be finished black in an attempt to determine the effect of the difference in light absorbing characteristics of the two surfaces. Records on these tanks will begin on March 1, 1952."

Drainage Studies - M. H. Gallatin, Homestead, Fla.

"The area of which the mulch plots is a part has been irrigated since the first of the year, so readings have remained higher than usually recorded. It has been interesting to note that in the natural cover and check plot areas the loss has been very rapid and at the end of a week these areas show readings at or near the wilting point. The rate of application for this area is approximately three quarters of an inch.

"In connection with the irrigation-moisture studies, with little or no rainfall since October 22, 1951, and an extremely low water table, the cycle of application for the cycle plot has been 6 to 8 days for this period. Usually during this time of the year the cycle has been a little bit wider 8 to 12 days and it is not until the end of February that the cycle must be shortened to a week to maintain adequate moisture.

"Plans are being made to attempt to clear up a slough of 2 or 3 acres in the western and northern part of this area. Walking the growth down with a Cat tractor pulling a bush and bog disk as well as 'Ammate' will be used. This pot hole has a heavy growth of wild rubber trees, Bay, Willow, and Myrtle growing in it and tends to hold moisture and makes for hard drainage of the immediate area.

"Various people in the area have tried reclaiming these areas but the methods are rather expensive. We believe that by walking these areas and spraying them with "Ammate" we can get rid of the growth and the following season begin disking the area and planting it. ,

"No chlorides samples were collected from our lines during the past period but soil and water samples brought to us and the Station during the past period have shown high concentrations. A trip through the truck-crop area to select sampling sites for tolerance studies shows that the area affected is 1/2 to 1/2 mile further west than last year.

"We are compiling a map on which we hope to keep a record of the area affected each year. From our data last year we can establish that boundary and we can easily plot in the new location.

"Actually this is not a movement of the front inland. This increase has been caused by the fact that for the past 2 years the rainfall during the summer has not been heavy or frequent enough to flush or leach out the chlorides and flush them from the area.

"Sampling of well water from the farmers and analyzed for chlorides shows that there has been an increase in concentration in many of the wells that have been usable in the past."

Drainage Studies - E. G. Diseker, Raleigh, N. C.

"After the termination of the Bethel Experiment it was deemed wise to make recommendations to Mr. Taylor (owner of farm) whereby more efficient drainage could be had on the poorly drained (old, 4-foot depth) tiled areas. It was also suggested that two of the closely spaced ditches (50-foot Spacing) on the east side of the canal could be eliminated. Thus the plots would have a spacing of 150 feet and still give efficient drainage. It was recommended that a shallow V-ditch be placed where each one of the old ditches was eliminated, when the experiment was started. These shallow V-ditches should extend from the first 2-foot depth lines of tile on the south, across the 3 and 4-foot depth tile to the main canal on the south, and each outlet should be protected by means of a 12-foot length culvert or section of terracotta pipe with joints properly cemented. This would drain the surface water from the low areas. Mr. Taylor was again reminded that the outlet canal should be cleaned out by means of a dragline, particularly for a distance of 500 feet above the tile main outlet to a distance of at least 1 mile below the tile outlet. He was advised that this should be done, otherwise the tile main would become silted in and covered with soil at the junction of the canal and tile main. Details on the above were also outlined to J. R. Highsmith, the drainage assistant at Bethel, so that he could assist Mr. Taylor with the V-ditches and the elimination of the small ditches."

Muck Drainage Studies - R. B. Hickok, Lafayette, Ind.

"Mr. Jongedyk has continued work on analyses of drainage data for preparation of a final report on the muck drainage project, Walkerton, Ind. Permeability coefficients derived from analyses of the draw-down data¹ are being compared with those estimated by various field and laboratory sampling methods. (The above footnote will appear at the end of Mr. Hickok's report on the next page.)

"It is interesting to note that draw-down measurements made at two locations on each plot and at different times of the year (April, June, July, and October) show that there are negligible differences in rates of drainage. Measurements made in July show some influence of evapotranspiration. Where the water table was about 0.5 foot to 2.00 feet and the rate of drainage was fairly slow, the rate of lowering of the water table was greater during the day than the night.

"In the case of the one plot where the water in the tile-outlet ditches was almost as low during July as it was during October, some difference in rate of lowering the water table was noted at greater depths where permeability is relatively low. This is shown in the following table:

Table 1.--Time for water table of the middle 16 feet between tile lines at 25-foot spacing to reach given depths under different conditions of evapo-transpiration. Controlled drainage plots, 1950, Purdue Muck Experiment Farm

	July 18-26	Oct. 19-Nov. 6
Depth of water table at start, below surface	0.94'	0.47'
Time to drain to 1.5' below surface	4 hrs.	5 hrs.
" " " " 2.0' " "	14 "	14 "
" " " " 2.5' " "	64 "	84 "
" " " " 2.9' " "	165 "	304 "
Depth of tile 3.6' - No rain interfering in either case		

¹Draw-down studies have been made on three of the muck-drainage plots. Water table was measured by 13 wells on a course perpendicular to a tile line. Tile lines are spaced at 25 feet. Previous drainage has been different and tile depths are different. Average water tables had been 16 inches, 25 inches, and 40 inches."

Drainage Studies - T. W. Edminster, Blacksburg, Va.

"Mr. Walter Turner, Soil Scientist, reports that permeability determinations have been completed on Sites VA-305 and VA-306 and work is also underway on Sites 307 through 314, which are samples recently obtained in the Piedmont Area of Virginia.

"Mr. Phelps Walker, Drainage Engineer, reports the following work: The Engineering Sub-Committee of the Soil Conservation Advisory Committee is preparing a revised handbook of recommended engineering practices for soil and water conservation in Virginia. A review of the drainage section of this handbook was prepared.

"A sub-committee of the ASAE National Drainage Committee is working up a set of recommended practices to be considered when designing tile-drainage systems. A review of the first draft of this manuscript was prepared and sent to Mr. J. H. Lillard, a member of the committee."

Sedimentation Studies - R. Woodburn, State College, Miss.

"Records of 'excessive rainfall' are available in State College Library under 'Report of Chief of Weather Bureau' from 1884 to 1935, incl. This information is contained in the Meteorological yearbook for the period 1935 to 1942. The Memphis office has the record 1942 to 1950, incl., in the Meteorological yearbooks but the library does not.

"It was found that the Weather Bureau definition of 'excessive' meant a rainfall of 0.01 inch per minute plus 0.20 inch before 1935. In 1935 to 1948, incl., it was 0.20 inch per minute plus 0.30. In 1949 and forward it was 0.01 inch per minute plus 0.20.

"The higher rate for 1935 to 1948, inclus., classifies very few rains in the excessive class, probably on an average not more than 3 to 4 per year. It is very doubtful if the erosion-producing potential of the rainfall for the year can be represented by any statistic derived from such a small number of rains per year. The validity of this statement may be shown by an examination of the soil losses from a bare plot on a 9 percent slope at State College from 1942 to 1950, incl.

Year	No. of rains with soil loss of over 3T/AC	No. of rains with soil loss of over 1T/AC
1942	5	14
1943	5	15
1944	21	27
1945	9	27
1946	18	29
1947	11	22
1948	11	24
1949	6	17
1950 (9 months only)	10	25

"During this period, there were from 14 to 27 rains per year causing erosion in excess of 1 ton per acre, a rather appreciable loss. There were from 5 to 21 rains per year causing soil loss of 3 tons or over per rain, which is a serious figure when its frequency is considered. It is well to keep these data in mind so as to not over emphasize the fairly rare rain causing the higher erosion losses.

"If the Weather Bureau excessive storms were all on the basis of the smaller criterion then they would possibly be suitable for deriving a yardstick of erosion potential for use in estimating the sediment-production rate of various years of record in the sedimentation survey."

IRRIGATION ENGINEERING AND WATER CONSERVATION DIVISION

Irrigation Water Management and Drainage Practices in the Production of Hay and Forage in the High Mountain Valleys of Colorado - H. K. Rouse, Gunnison, Colo.

"The Feeding Experiment being conducted by the Gunnison County Feeding Research Corporation with the cooperation of Colorado A & M College, BPISAE, and this project is proceeding in accordance with plan, and has reached the mid-point of the test. The results for the first 56 days of the scheduled 120-day trial are shown in the table.

Table 1.--Biological assay, Gunnison County Feeding Research Corporation, Gunnison, Colo.

Summary of Results; Dec. 5, 1951, to Jan. 30, 1952; 56 days

Pen No.	Ration	Weight			Total hay consumed	Hay consumed per animal day	Gain per animal day	Pounds hay per pound gain
		12/5/51	1/30/52	Gain				
1	NMC-20%	4,130	4,635	505	7,555	13.49	0.90	14.96
2	NMC-39%	4,085	4,660	575	7,433	13.28	1.03	12.93
3	OE	4,175	4,415	240	7,309	13.05	.43	30.45
4	NPL	4,115	4,275	160	7,146	12.93	.29	44.66
5	PE	4,075	4,450	375	7,030	12.56	.67	18.75
6	OL	4,140	4,165	25	7,164	12.79	.04	286.50
7	NPE	4,090	4,415	325	7,350	13.13	.58	22.61
8	PL	4,120	4,185	65	7,185	12.83	.12	110.54

Explanation of Ration Symbols:

1. NMC-20%. Hay cut mid-season, nitrogen fertilizer plus 1 lb. 20% cake per A. D.
2. NMC-39%. Hay cut mid-season, nitrogen fertilizer plus 1 lb. 39% cake per A. D.
3. OE Hay cut early, no fertilizer
4. NPL Hay cut late, nitrogen and phosphorous fertilizers
5. PE Hay cut early, phosphorous fertilizer
6. OL Hay cut late, no fertilizer
7. NPE Hay cut early, nitrogen and phosphorous fertilizers
8. PL Hay cut late, phosphorous fertilizer

This experiment is conducted with the cooperation of Colorado A & M College, Bureau of Plant Industry, Soils, and Agricultural Engineering, and Soil Conservation Service--Research.

"It should be realized that this is not an experiment planned to fatten beef for market. Rather it is one aimed at determining the relative values of hay, produced at different fertility levels and harvested at different maturities. In the Mountain Valleys, all pastures are snow-bound and feeding is necessary during a 4-to 6-month period.

"The gain per animal day varies from practically no gain to approximately 1 pound. During the corresponding period in the similar test conducted a year ago,

gains ran from 0.4 to 1.3 pounds per animal day.

"Then, the ratio of pounds of hay consumed to pounds gained varied from 7.55 to 21.64 as compared with 12.93 to 286.50 in the present test. In both tests, hay was kept before the animals at all times and they could have all they would eat. Even though the 80 heifer calves undergoing these tests this year are smaller, by an average of 35 pounds per animal, then those used last year, average hay consumption this year is up more than 40 percent, from 9.2 to 13.0 pounds per animal day. In partial explanation, the winter weather has been unusually severe, even for Gunnison, with greater proportions of the feed needed for maintenance and less available for growth.

"Results this season are comparable with those of last year in that the amounts of late cut hay required per pound of gain are much greater than for early cut hay. The addition of 1 pound of 39 percent protein supplement per animal day this year resulted in an increase in the rate of gain per day of 0.6 pound as compared with a similar differential of 0.4 pound last year."

Drainage and Irrigation Studies - W. D. Criddle, Boise, Idaho.

Drainage Investigations - Gem County - "George B. Bradshaw continued the drainage investigations in Gem County during January. Studies in a water-logged Muck-soil area indicate that open or tile-drainage systems are not feasible for draining such soils underlain with artesian pressure.

"The permeability of the artesian aquifer immediately underlying the Muck soils is extremely high, while that of the overlying Muck is very slow. This causes considerable heaving in the bottom and sloughing along the sides of the open test drain. In some areas the Muck soils are very unstable and in a semi-fluid state. The installation and maintenance of open or tile drains under such conditions is practically impossible.

"Drainage of these soils is believed to be most feasible by pumping. A study is being made to determine the proper location and design of a series of drainage wells to lower the artesian pressure under the area."

Surface Methods of Irrigation - Black Canyon Project - "The 1951 Progress Report of the irrigation studies on the Black Canyon Project was completed and sent to cooperators early in January.

"Intake rates of soils on the surface plots as measured by the double ring infiltrometer show a definite downward trend. The average intake rate in 1949 was 0.37 inch per hour as compared with a rate of 0.14 inch per hour for 1951. One theory for this decrease in intake rate is that the waters of the Payette River which were used for irrigation are extremely pure and application of water may be leaching the salts from the soil causing them to tighten up. Some soil amendment may be necessary if these soils are to maintain a reasonable intake rate."

Sprinkler Irrigation Studies - Black Canyon Project - "The effect of sprinkler irrigation upon soils of the Black Canyon Experimental Tract as measured by intake rates determined by double ring infiltrometer methods is shown in the following table:

<u>May 1949</u> <u>In./hr.</u>	<u>Nov. 1949</u> <u>In./hr.</u>	<u>Mar. 1950</u> <u>In./hr.</u>	<u>Aug. 1950</u> <u>In./hr.</u>	<u>April 1951</u> <u>In./hr.</u>	<u>Aug. 1951</u> <u>In./hr.</u>
0.33	0.28	0.24	0.30	0.30	0.28

"Figures shown are average rate water entered soil for the last 8 hours of a 48-hour test run. The May 1949 intake rate tests were run on the plot before the native vegetation had been disturbed. The cropping pattern has been: 1949 - oats; 1950 - barley; and 1951 - red clover.

"Since the intake rates of the soils on the sprinkler irrigation plots have remained about constant and since the soils are similar to those under the surface irrigation plots, we have attempted to determine the reason for this variation. During the 3-year period 1949-51, considerably less water has been applied to the soil under the sprinkler plots than was applied under the surface plots. It is felt that perhaps the salts have not been leached from the soils under the sprinkler side, and, therefore, intake rates have remained up to about the same rate which occurred under virgin conditions."

Irrigated Pastures at the North Platte Experiment Station - F. B. Hamilton, Lincoln, Nebr.

"For the past three growing seasons records of water application have been kept on irrigated pastures at the North Platte Experiment Station. The pastures consist of alfalfa and brome grass. High production has been maintained by careful management and the addition of manure. During the 1950 and 1951 soil-moisture samples were also taken at the beginning and end of the season. Each year comparisons have been made between water used and computed consumptive use based on the Blaney-Criddle Method.

"The following table shows a summary of the data for the 3 years:

Table 1.--Computed water requirement and measured water use of irrigated pasture
North Platte Experiment Station

1949

Month	Estimated consumptive use (inches)	Effective rainfall (inches)	Irrigation applied (inches)	Total water applied
April	3.71	1.33		1.33
May	5.18	4.60		4.60
June	6.01	4.21	0.39	4.60
July	7.45	1.86	4.27	6.13
August	6.04	.94	9.20	10.14
September	4.36	1.31	8.14	9.45
October	3.34	1.08	3.54	4.62
	36.09	15.33	25.54	40.87

Table 1.--Computed water requirement and measured water used of irrigated pasture
North Platte Experiment Station--Continued

1950				
Month	Estimated consumptive use (inches)	Effective rainfall (inches)	Irrigation applied (inches)	Total water applied
April	3.26	1.68		1.68
May	4.75	4.11	2.69	6.80
June	5.87	1.19	9.69	10.88
July	6.82	5.66	6.60	12.26
August	5.64	4.29	1.07	5.36
September	4.44	2.37		2.37
October	3.65	0		0
	34.43	19.30	20.05	39.35
			Loss in Soil Moisture	1.18
			Total Consumptive Use	40.53
1951				
April	3.33	2.33		2.33
May	4.95	5.94		5.94
June	5.31	7.92		7.92
July	6.85	4.72		4.72
August	5.83	1.45	9.50	10.95
September	4.21	1.95		1.95
October	3.15	1.02		1.02
	33.63	25.33	9.50	34.83
			Gain in Soil Moisture	2.74
			Total Consumptive Use	32.09

"Results for 1951 were somewhat different than those of the previous 2 years. Much less irrigating was done. There were several long periods of very humid weather which may have affected the actual water requirement without having any effect (except as humidity is related to temperature) on the computed requirement. It is interesting to note that the effective rainfall for April through July was 20.61 inches while the estimated consumptive use for that period was 20.44 inches and that no irrigation water was applied during that period.

"The distribution of water on these pastures has not been as uniform as would be desirable. New pastures were sown last fall on which much better water control and distribution will be possible. It is planned to continue the study under more nearly controlled conditions on these new pastures."

Irrigation Studies - S. J. Mech, Prosser, Wash.

Consumptive Use - "Consumptive use data for the 1951 wheat-alfalfa has been completed and is presented in table 1 on page 22. These data are based on soil-moisture samples taken 2 days before irrigation begins and 3 days after the water is turned off.

Table 1.—Soil moisture use by 1951 wheat-alfalfa under three ranges of available soil moisture

AVAILABLE MOISTURE 100-- 60%		
Period		Average loss
From	To	Inches/day
3/28	4/20	0.02
4/20	5/18	.18
5/18	6/10	.28
6/10	6/26	.36
6/26	7/11	.32
7/11	8/16	.06
8/16	9/7	.20
9/7	9/28	.20
9/28	10/30	.14

AVAILABLE MOISTURE 100 - 35%		
3/28	5/5	0.02
5/5	6/16	.23
6/16	7/10	.30
7/10	8/14	.02
8/14	9/12	.18
9/12	9/22	.14
9/22	10/30	.13

AVAILABLE MOISTURE 100 - 15%		
3/28	5/15	0.05
5/15	6/4	.17
6/4	7/9	.27
7/9	8/10	.04
8/10	10/30	.10

TOTAL CONSUMPTIVE USE IN INCHES

	Period	Days	Wet	Med.	Dry
Wheat	3/28-7/10	104	22.18	17.62	15.29
Wheat harvest-Alfalfa seeding	7/10-8/14	35	2.36	.70	1.64
Alfalfa seeding	8/14-10/30	77	13.20	11.56	7.70
Total	3/28-10/30	216	37.74	29.88	24.63

"The results show a smaller total use and a lesser peak use with a decrease of soil moisture before irrigation. In this respect it repeats what has been obtained from the four other crops in the rotation. The conclusion is quite obvious: considerable less water is required if the available soil moisture is permitted to drop to 35 percent or less before irrigation. The fact that our yield was 65.2; 67.4, and 51.9 bushels per acre for the wet, medium, and dry plots respectively, emphasizes the fallacy of maintaining a high moisture content.

"In a recent discussion with Dell Shockley, Head, Irrigation Section, Soil Conservation Service, Portland, Oregon, a question has been raised as to what criteria should be used to determine the time for beginning an irrigation. A 35

percent available soil-moisture content in a root zone whose total available soil-moisture capacity is 9 inches may be safe enough, but a soil or root zone whose total capacity is only 4-1/2 inches may require a different criteria. In our discussion it was brought out that even though the 35 percent of the 4-1/2-inch capacity may be safe enough for sustained plant growth, it may not be safe enough when the precision of soil-moisture determinations and speed with which irrigation water may be delivered are considered. In all probability, holding off the irrigation until only 35 percent of the available soil moisture was left would not provide an adequate safety factor in very light or shallow soils. It was decided that for safety sake, it would be better to irrigate when 2-1/2 or 3 inches of water are still left. This means that a soil whose available root-zone capacity is 4-1/2 would be irrigated when the available soil-moisture content would be 60 - 67 percent of the total capacity.

"It was felt that the criteria for expressing the time when irrigation should be applied would be more generally applicable if it were expressed in inches of water remaining in the root zone, instead in percent of available total capacity. The desirable amount of this remaining moisture will in the last analysis be dependent on the rate of consumptive use and precision with which the soil-moisture determinations express the moisture conditions in the root zone plus the speed with which irrigation water can be applied.

"The above recommendation will result in the maintenance of a higher moisture content on the soils with a lower water-holding capacity. The resulting consumptive use will be higher which together with the decreased efficiency accompanying the light but frequent irrigations will increase the total water requirements for light or shallow soils. This helps to explain the higher water allotment required by the lighter soils. It may explain part of the admittedly greater water requirement on soils with a low water-holding capacity or a shallow root zone."

Irrigation Summary - 1951 Wheat - "Table 2, page 24, shows the irrigation summary for last year's wheat. It shows roughly a 2:1 ratio between the field intake rate on the 2 percent furrow grade and that on the 7 percent slope. It shows also a conspicuous increase in field intake rate as the moisture before irrigation is decreased. The rate for the dry plots is more than three times as great as that on the wet ones. The rates for the 7 percent slope are 0.08, 0.19, and 0.28, while those from the 2 percent are 0.19, 0.37, and 0.64 inches per hour for the wet, medium, and dry plots respectively. (The 2 percent furrow grade figures are given in a table which is not included in this report. Anyone interested can obtain a copy from the project.)

"The influence of stream size is also shown on the various irrigation characteristics. It is apparent that stream size did increase infiltration on an average from 0.16 to 0.21 on the 7 percent slope and from 0.31 to 0.47 inch per hour on the 2 percent slope. The small values in the 3q wet plots are due to limitation of measuring equipment. The infiltration rates for some irrigations were so small that greater precision was needed than the equipment provided.

"Each table contains a comprehensive summary of irrigation characteristics. For example, the table which is not included with this report, shows that the "q" plots on the 2 percent furrow grade received a total application of 55.0 inches of which 34.8 ran off. The 20.2 inches difference is considered as infiltration. The runoff was 63.3 percent of the 55.0 inches application. It carried 2.22 tons per acre of soil from the bottom of these plots during the season.

"Soil-moisture sampling 2 days before irrigation and 3 days after irrigation showed a gain of 14.26 inches. When consideration is given to the amount of moisture used between these two sampling dates, the amount of moisture added by irrigation is increased to 20.98. This value is 103.9 percent of the 20.2 inches which infiltrated the soil. The average rate of application during the 107 hr. - 55 min. of irrigation was 0.51 inch per hour. The runoff averaged 0.32 inch per hour and the infiltration 0.20."

Drainage Research in Utah - V. E. Hansen, Logan, Utah

"The following is an abstract of Mr. Day L. Bassett's thesis entitled 'The Discharge Coefficient in the Coordinate Method or Measuring Pipe Flow.'

"The coordinate method for measuring flow of water from horizontal pipes first appeared in the literature in 1904 when C. S. Slichter described the general method developed earlier by J. E. Todd.'

"Since Slichter's original article, several writers have proposed this method. F. W. Greve at Purdue University, reported in 1928 some carefully conducted tests to determine the discharge coefficient for the pipes tested. This work was later amplified by other writers. Nevertheless, at the present time, most writers are still assuming the coefficient of discharge equal to unity, much remains to be done on this problem. It is with this in mind that the thesis was undertaken by Mr. Bassett. The objectives of the research described in his paper are: '1. To study the nature of the coefficient involved in the free discharge of water from a horizontal pipe. 2. To suggest a procedure for applying the coordinate method of discharge measurement which realistically embodies this coefficient.

"The coordinate method for estimating pipe flow has been accepted as practical in certain field situations. The method as heretofore described in the literature is, however, limited in usefulness. Theoretical presentations of the method did not involve the discharge coefficient, and experimental data were useful only under the conditions tested. Lack of uniformity of thought and technique among the several authors was thought to be due to the complexity of the hydraulic phenomena involved. An investigation of the discharge phenomena was undertaken in 1951 at Utah State Agricultural College in an attempt to improve the utility and accuracy of the coordinate method. A discharge coefficient was assumed to exist in the basic discharge equation and was shown from theory to be a function of velocity distribution within the stream of water. Laboratory investigations made at Utah State Agricultural College, substantiated by experimental data from Purdue University, confirm the presence of a discharge coefficient. Values of this coefficient ranged between 0.9 to 1.6 in the study reported here.

"Factors affecting the magnitude of the coefficient are those relating to velocity distribution. Most important of these are the position along the jet, pipe size and stage of flow where viscosity is constant.

"A procedure has been suggested for applying the coordinate method which embodies the coefficient. Dimensionless parameters have been defined which group all the experimental data into a single linear relationship. This significant development is most valuable in that a single linear function now represents the relationship between the coordinates and the discharge for all coordinates and pipes tested and may according to the theory held for others as well. Seldom will the function yield discharge values which are more than 8 percent in error.' The

equation of the straight line obtained statistically in terms of dimensionless parameters is equal to:

$$\frac{Q}{\sqrt{gx^5}} = 0.844 \frac{a}{\sqrt{yx^3}} \quad 1.046$$

or in terms of discharge

$$Q = \left[0.844 \sqrt{g \left(\frac{a}{\sqrt{yx^3}} \right)} \right] \frac{ax}{\sqrt{y}} \quad 0.046$$

which results in a coefficient of discharge of C being equal to

$$C = 1.19 \left(\frac{a}{\sqrt{yx^3}} \right) \quad 0.046$$

"In statistical terms, these functions can be used to estimate the flow of a single trial under conditions of this investigation with accuracy greater than 92 percent of Q about 95 times in 100. Statistically the discharge coefficient varied between 0.99 and 1.20 over the range tested.

"A field investigation is considered necessary to supplement the work reported here. This study should test the applicability of the method under a wide range of field conditions, should suggest refinements to the method, and should be helpful in preparing a simple procedure for field application."

"The above reported investigations show that when the discharge from a horizontal pipe is measured by the coordinate method, the result might be a considerable error unless the appropriate discharge coefficient is applied to the equation. The results of this study can be used with a fair degree of accuracy in predicting the actual discharge, however, further field studies as indicated herein will be made in order to further evaluate the method for field application.

"Further details can be secured from Mr. D. L. Bassett's thesis entitled 'The Discharge Coefficient in the Coordinate Method for Measuring Pipe Flow' submitted January 1952 to the Irrigation and Drainage Department at the Utah State Agricultural College, Logan, Utah."

Canal Bed Materials - C. W. Lauritzen and W. W. Rasmussen, Logan, Utah

"It appears from the data which have been collected on the permeability of canal bed materials, that the permeability of dry-packed columns of bed material gives the best correlation with seepage losses determined by ponding measurements; that is, better than the permeability of compacted or stratified material.

The equation:

$$S = 0.15x - 0.01$$

where

S = seepage as determined by pending measurements
x = permeability of dry-packed material

"Frequently it is found that individual ponding measurements vary widely from this general relationship. Where this is the situation there is evidence that seepage is governed primarily by non-conformity, such as the presence of gravel lenses, rather than the over-all permeability of the bed material."

Infiltration and Other Studies - Ventura County - G. M. Litz and W. T. Gish, Los Angeles, Calif.

"On January 23 and 24, after some 7 inches of rain during the previous 10 days, a second set of soil samples was secured at each of the 20 rainfall penetration stations. Indications are that considerable rainfall is penetrating below the root zone of the crops to the underground water supply. At stations where the soils are light and in some plowed fields, penetration is below 9 feet. On heavier textured valley soils, penetration is from 6 to 8 feet."

Replenishment of Underground Aquifer Studies, San Joaquin Valley - D. C. Muckel, Berkeley, Calif., and E. S. Bliss and C. E. Johnson, Bakersfield, Calif.

Conference on San Joaquin Valley Studies - D. C. Muckel - "A conference was held with representatives of the North Kern Water Storage District in Bakersfield, Calif. The results of a reconnaissance soil survey made on a proposed spreading area was discussed as was the possibility of various soil treatments to improve percolation. The District is now constructing 400 acres of spreading grounds. The estimated cost for leveling, diking, and turn-out structures is \$237 per acre. Any treatment, such as cotton gin trash or planting of Bermuda grass will be in addition to this cost.

"The present outlook is that water will be available for spreading this spring. We plan to concentrate our studies on the large areas so as to check the results obtained on small test ponds and in the laboratory."

Field Studies on Infiltration - E. S. Bliss - "Field work on the proposed 160-acre water-spreading area near Minter Field was completed and permeagraphs drawn up for all the holes drilled. It was hoped that as a result of this work the field could be divided into relatively 'good' and 'poor' areas from the permeability standpoint and that this delineation would form a basis in the placement of treatments and in the evaluation of their effects. However, the soil is so extremely variable that with a grid spacing of 300 feet it was not possible to cut out sizeable 'good' and 'poor' areas. Since treatment will be handled on a large scale it is believed the entire area can be treated as a unit and comparisons between treated and untreated portions will be valid. A report of the findings and recommendations as to treatments will be completed shortly.

"A less intensive field study of a 130-acre area along the Gallaway Canal located about 5 miles southeast of the Minter Field site has been completed and is also being written up. Field study of the third site contemplated for spreading near Famosa, 5 miles north of the Minter Field site is almost complete and will be included in the report. On the basis of these field studies it appears that surface treatments of cotton gin trash and Bermuda grass planting should be effective in the Callaway and Famosa areas where surface clogging apparently will

limit infiltration rates. At Minter Field there is a limiting zone at anywhere between 1 foot and 4 feet in most places. The limitation is usually a 'hardpan' like layer that apparently could be shattered by ripping where not too deep. If equipment is available to rip a 36-inch depth it is believed that about two-thirds or three-fourths of the area would be materially benefited."

Decomposition Studies - C. E. Johnson. - "Organic matter decomposition studies are being continued. The 30-day decomposition period has been completed and results calculated. Cotton gin trash decomposed 37 percent by weight, alfalfa 45 percent and redwood sawdust a negligible amount. The addition of nitrogen as ammonium nitrate to comparable samples increased the decomposition rates about 8 percent in the case of the cotton gin trash, but only increased the decomposition of alfalfa by about 3 percent. The decomposition rate of redwood sawdust was not increased significantly by addition of nitrogen. The nitrogen was applied at the rate of 1.5 percent by weight of the organic materials added. Microbial counts on these decomposition samples are not yet completed."

Water Supply Studies Tehachapi Soil Conservation District - W. W. Donnan, Los Angeles, Calif.

"An attempt has been made to estimate probable seasonal runoff in the mountain areas of Tehachapi Soil Conservation District, Kern County, where no seasonal measurements have been made. Previously it has been reported that the calculated 50-year mean seasonal runoff was 2 inches over the watershed or about 100 acre-feet per square mile. Using this figure as a basis, we used Toxell's curves of 'Frequency of Seasonal Runoff' to secure seasonal magnitude. Then taking the measured seasonal runoff from the area below Kernville on the Kern River (this area has similar topographic and hydrologic characteristics) we determined the magnitude and frequency of runoff to the Kern River. By equating the Tehachapi and Kern River frequencies we secured the ratio between the two. The results of this study indicate 2 percent of the time, the seasonal runoff to the Kern River below Kernville equals or exceeds 450,000 acre-feet; and 2 percent of the time the seasonal runoff from Tehachapi Valley mountain area equals or exceeds 450 acre-feet per square mile, etc. To determine the runoff for individual seasons, we took the seasons measured runoff to the Kern River and secured the corresponding estimated runoff in Tehachapi Valley."

Southern California Rainstorms - V. S. Aronovici, Pomona, Calif.

"Of special interest during this month was the heavy rainfall. On the first of January we had a total of 9.88 inches of rainfall. Subsequently, during January we had a series of minor storms cumulating in one major storm. Tabulated below is the rainfall record obtained from the key Weather Bureau Station of Pomona, Calif.

<u>Date</u>	<u>Rainfall, inches</u>	<u>Date</u>	<u>Rainfall, inches</u>
January 7-8	0.41	January 16	2.86
January 12-13	1.87	January 17	.61
January 14	.01	January 18	1.81
January 15	.14	January total	7.71

Total seasonal rainfall to date, 17.59 inches. Normal, 9.10 inches.

"For the first time in 7 years water-spreading facilities of San Antonio Canyon, near Pomona, functioned. At a peak period (1 hour and 1/2), 3,000 second-feet were delivered to the 1,000-acre spreading grounds. A sustained flow of from 40 down to 20 second-feet has continued to flow into the spreading

grounds. Very little erosion damage was observed in the citrus orchards of southern California with isolated exceptions. Serious sheet and gully erosion occurred in Ventura County on the steeply sloping cultivated lands."

Use of Water by Phreatophytes - H. F. Blaney, Los Angeles, Calif.

"The water consumed by phreatophytes (water-loving plants growing along streams and moist-areas) represents one of the largest source of reclaimable water in the Southwestern States. However, very little is known about the amount of water that might be reclaimed by lowering the water table and replacing salt cedar and other phreatophytes with grain, grass, or other beneficial plants. Technical sub-committees of inter-agency technical committees in the Pacific Southwest and in New Mexico have been considering this problem in the Colorado River, Pecos River, and Rio Grande basins for several months and have recommended additional research studies to determine the use of water by phreatophytes and replacement vegetation. As a member of two of these sub-committees, studies made in California and New Mexico some years ago by the Irrigation Division have been reviewed.

"The sixth meeting of the Salt Cedar Technical Sub-committee (of the Salt Cedar Action Committee of New Mexico consisting of representatives of federal and State agencies) was attended at Albuquerque January 15-16. A statement describing the method developed by the Irrigation Division for transposing measured consumptive use by salt cedar in the Pecos River Basin to the Rio Grande Basin was prepared for the appendix of the final report of the committee. This statement included examples of computed consumptive-use coefficients for salt cedar and sacaton based on measured consumptive use and temperature records, and percent of day-time hours and growing season in the Pecos River Basin, Carlsbad, N. Mex., using formula $U = KF$. These are shown in table 1.

Table 1.--Examples of consumptive use coefficients for phreatophytes computed from climatological data

Location and classification	Year	Depth to water	Growing season or period	Consumptive use factor (F)	Consumptive use (U)	Coeffi- cient (K) for period
		<u>Feet</u>			<u>Inches</u>	
Carlsbad, N. Mex.						
Salt cedar	1940	2	Apr. to Sept.	40.72	48.61	1.19
Salt cedar	1940	3	Apr. to Sept.	40.72	43.95	1.08
Sacaton	1940	2	Apr. to Sept.	40.72	37.98	.93
Sacaton	1940	4	Apr. to Sept.	40.72	32.82	.81

"Table 2 illustrates how data at Carlsbad (Pecos River Basin) can be transposed to Socorro (Rio Grande Basin) by using these coefficients.

Table 2.--Computed consumptive use of water by salt cedar and sacaton at Socorro, N. Mex., for frost-free period

Vegetation	Depth to water table	Frost-free period	Coefficient (K)	Consumptive use factor (F)	Computed consumptive use (U)
	<u>Feet</u>				<u>Inches</u>
Salt cedar	2	Apr. 10 - Oct. 25	1.20	41.34	49.6
Salt cedar	3	Apr. 10 - Oct. 25	1.10	41.34	45.5
Sacaton	2	Apr. 10 - Oct. 25	.95	41.34	39.3
Sacaton	4	Apr. 10 - Oct. 25	.80	41.34	33.1

3/10/52

